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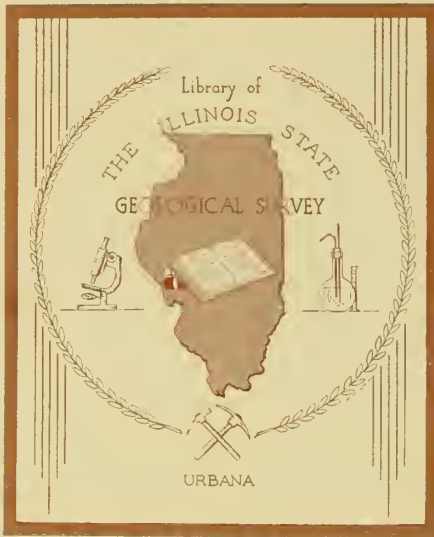


LOWER PENNSYLVANIAN
CLAY RESOURCES OF
ROCK ISLAND, MERCER, AND
HENRY COUNTIES, ILLINOIS

Walter E. Parham

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LOWER PENNSYLVANIAN CLAY RESOURCES OF ROCK ISLAND, MERCER, AND HENRY COUNTIES, ILLINOIS

Walter E. Parham

ABSTRACT

Some 95 samples of the underclays occurring in the Spoon and Abbott Formations (lower Pennsylvanian) of Rock Island, Mercer, and Henry Counties, Illinois, were tested to determine their suitability for use in making fired clay products.

This area of Illinois contains underclay deposits of good quality capable of a wide variety of uses. The overburden is less than 40 feet thick over 50 percent of the underclays. At present, only one underclay and one shale pit are in operation in the three counties.

All of the samples have fusion temperatures below PCE cone 28, and about half of the clays tested have light firing colors. Various samples are suitable for stoneware, structural clay products, sewer pipe, drain tile, flower pots, art pottery, bonding clay, and lightweight aggregate.

INTRODUCTION

This report on the clay resources of the Spoon and Abbott Formations of the Pennsylvanian System in Rock Island, Mercer, and Henry Counties, Illinois, is the third in a series of guides to locating and exploiting new light-burning clay deposits. Reports on the clay resources of LaSalle and Knox Counties already have been published (Parham, 1959, 1960).

Most of Rock Island, Henry, and Mercer Counties is covered by Pleistocene glacial deposits. The older coal-bearing rocks of the Pennsylvanian System and their associated clays are exposed in the streams along the bluffs of the Rock and Mississippi Rivers and in other streams that have cut through the region's widespread glacial deposits. The type of clay sampled for this report is called underclay and generally is found directly beneath coal beds. Underclays are nonlaminated, gray, fine grained, sedimentary rocks. They can vary in thickness from a few inches to ten or fifteen feet.

Sampling was limited to underclays of the Spoon and Abbott Formations. However, preliminary investigations of the spores of some coals of western Rock Island County by R. M. Kosanke of the Illinois State Geological Survey have shown that there are at least two coals in this region containing spores like those found in coals of the Caseyville Formation of southern Illinois. It is possible that some of the underclays of western Rock Island County listed in this report as being in

the lower Abbott Formation will be found to belong to the Caseyville Formation when the current spore study has been completed.

A total of 95 samples, two of which are shale, were studied. The samples were taken from the locations shown in figure 1. A few of them were obtained from underground mines of the Rock Island (No. 1) Coal, but most were from outcrops.

GENERAL GEOLOGY OF THE AREA

The Pennsylvanian rocks of Rock Island, Mercer, and Henry Counties appear to lie flat in most areas, but they actually dip very gently to the southeast. The thickness of the Pennsylvanian underclays may be extremely variable within a small area. Careful geologic correlation and measurement of the exposed rocks in the prospect area, coupled with the study of cores of the same rocks from the covered intervals, should be made before attempting to exploit such deposits.

Wanless (1952) stated that some of the rocks in this region were deposited in estuaries a few hundred yards wide and several miles long. The Rock Island (No. 1) Coal, and the limestone above it, can vary from 1 to 5 feet in thickness in less than 100 yards near the edges of these estuaries. Such variation causes equivalent geologic sections to differ greatly in appearance even though they may be quite close together.

Small faults of five- or ten-foot displacement have been observed in western Rock Island County. In addition, in some places throughout the region younger Pennsylvanian sandstones have cut through the older layers of Pennsylvanian rocks. Either of these factors may account for the sudden termination of an apparently continuous underclay unit. The delineation of such a deposit thus can become very complex. It is recommended that competent geological assistance be utilized during the initial development of underclay resources.

At present, only one deposit of underclay and one of shale are being used commercially in the three counties. Earlier in the 1900's underclays were used locally in all of these counties, but little trace of this activity is left today. A deposit in western Rock Island County was mined from time to time and the raw material was hauled by wagon to Muscatine, Iowa (Lines, 1917), for the manufacture of drain tile. At Sears, in Rock Island County, clay was mined for use in the manufacture of fire brick. In 1925 underclay was mined at Griffin in Mercer County, but this operation has long since been abandoned. Other ceramic and mineralogical data regarding clays and shales from this area can be found in Lines (1917), Parmelee and Schroyer (1921), Grim et al. (1957), White and Lamar (1960), and White (1960).

A detailed geologic account of this region is found in the publications by Green (1870), Savage and Udden (1921), Shaw (1873), Wanless (1929, 1952), and Worthen and Shaw (1873). The formation names used in this report are those used in the Illinois State Geological Survey's "Classification of the Pennsylvanian Strata of Illinois" (Kosanke et al., 1960).

Owing in part to the rapid lateral variations in the thickness of the rocks involved and in part to the lack of detailed geological information in parts of the counties studied, it was difficult, in places throughout the area, to determine exactly what unit was being sampled. The stratigraphic relationships of these rocks is being investigated by Neal O'Brien, Illinois Geological Survey, who also aided in identifying the various stratigraphic units in this report.

REPORT OF TESTS

Included in this report on existing clay deposits in Rock Island, Mercer, and Henry Counties is information concerning sample locations, thickness, overburden, type of underlying and overlying sediment, results of tests on the physical properties, and suggestions for uses. The test results include the drying and firing shrinkage of the clay, water of plasticity, fired colors, and bonding properties. The clay minerals in each sample were identified by x-ray techniques. The x-ray analyses were used as a basis for selecting samples for bonding tests and for fusion temperature tests.

Extrusion and Firing of Test Bars

Each sample of clay was air dried and crushed to particles approximately one-fourth inch or less in diameter. The sample then was mixed with sufficient water to develop plasticity. The percentage of water added in each case was determined and recorded as water of plasticity. The plastic clay was extruded into three individual test bars, each 1 by 1 by 6 inches. The bars were air dried for at least two days, then measured to determine the percentage of drying shrinkage. The first bar was fired at 1832° F, the second at 2012° F, and the third at 2200° F. After each firing, the test bars were measured to determine the percentage of firing shrinkage.

Most of the samples in this study were obtained from outcrops, and weathering probably has altered the burning color of the clay. A weathered, light-burning clay generally burns darker than the unweathered clay from the same deposit, owing to the oxidation of pyrite in the clay and to the fine dissemination of iron throughout the clay deposit. For a better indication of true burning color, it would be necessary to obtain unweathered samples of the clay from drill holes near the area in question.

In some clays, soluble iron salts will migrate outward to the surface of an unfired brick during the drying period. When the brick is fired, the high concentration of iron will be on that surface of the brick through which the most drying has taken place, and the fired color generally will be dark brick red on that surface, whereas the other surfaces may be considerably lighter.

Samples 1581, 1627, 1629, 1703, 1707, and 1718 displayed this iron discoloration, but the fired colors, which are listed in the tables for the various firing temperatures, are taken from the surfaces not discolored by the iron.

High-Temperature Properties

The 10 samples that proved to have, on the basis of mineralogical data obtained by x-ray analyses of each sample, the largest amounts of kaolinite were selected for tests to determine whether their fusion points were PCE (pyrometric cone equivalent) 28 or greater. A small cone was made from each sample and mounted in a gas furnace with standard cones of PCE 28, 29, 30, and 31. The sample was heated to its fusion point and compared with the standard cones. The fusion point of all samples tested fell below PCE cone 28, making them unacceptable for use as medium heat duty refractories, which require materials with PCE values of at least 29 (Parham, 1959, p. 7).

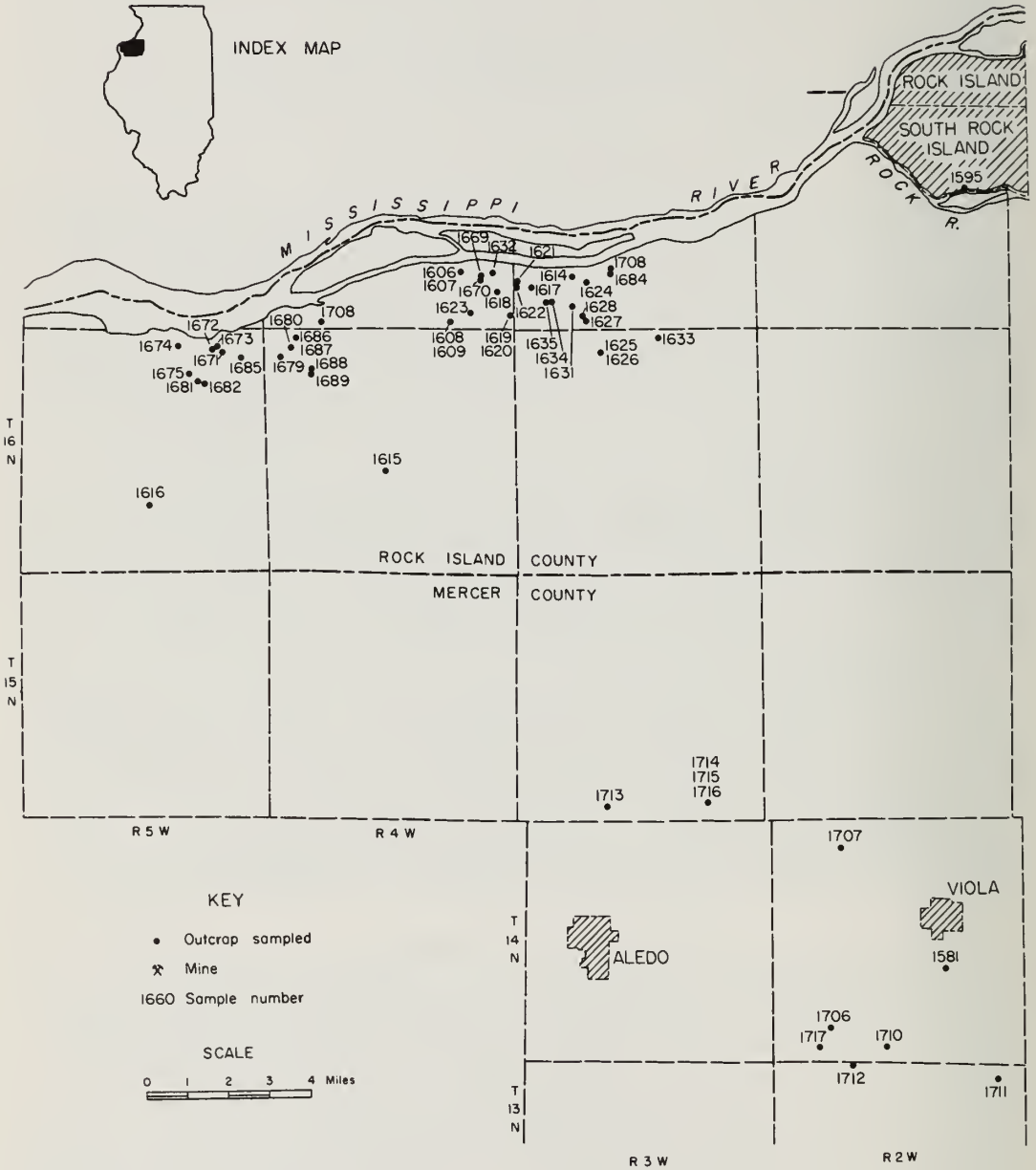
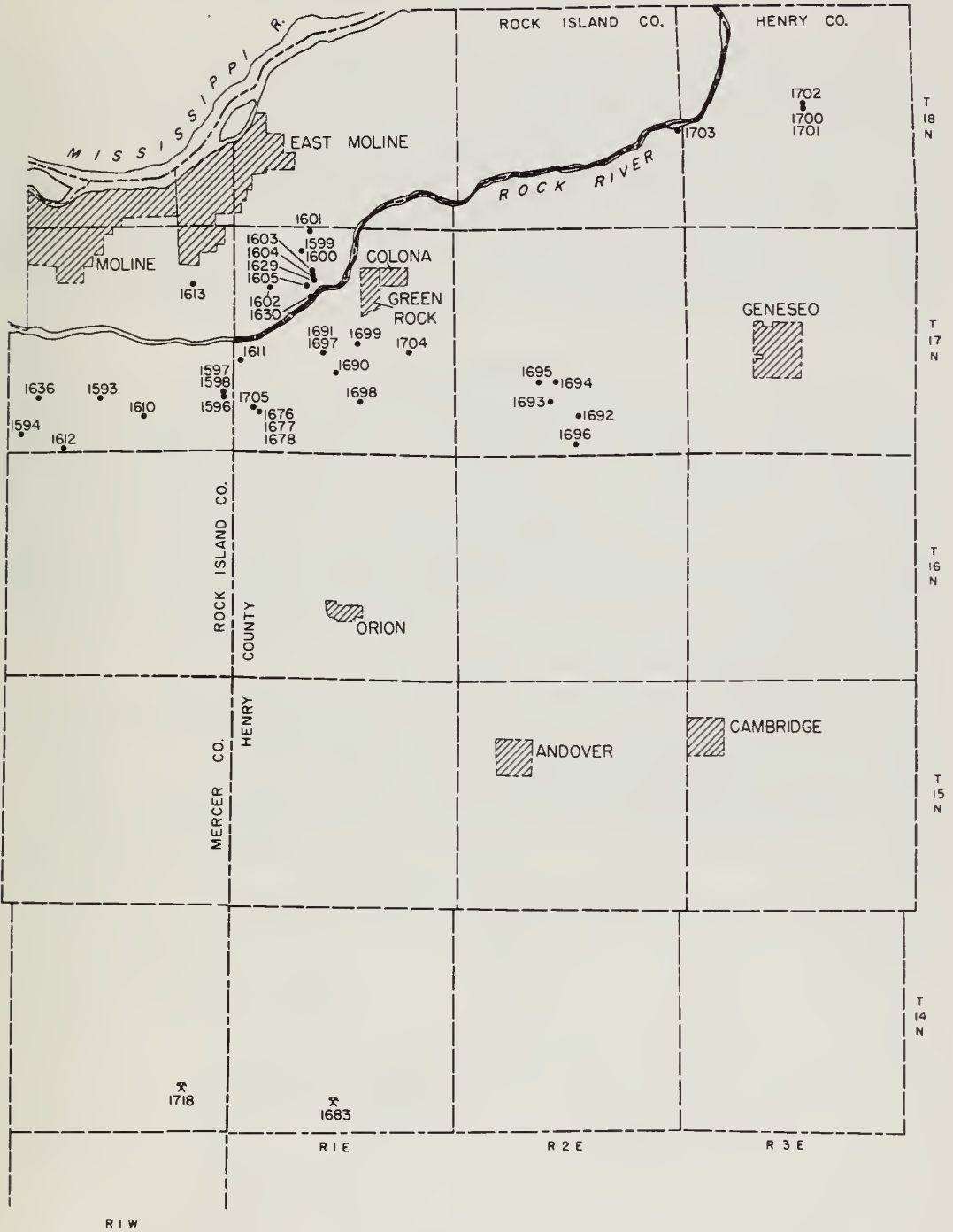


Fig. 1 - Map of area studied showing

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locations from which samples were taken.

Bonding Tests

Some underclays have been found to be satisfactory for use as bonding clays for foundry sands. The clay mineralogy of an underclay may be used effectively in predicting its bonding properties. About one-fourth of the samples were selected for bonding tests, on the basis of x-ray analyses of their clay minerals.

Mixtures of 92 percent foundry sand and 8 percent clay were made and mixed with varying amounts of water. The tests were then run in a manner described in the "Foundry Sand Handbook" (American Foundrymen's Society, 1952). The green compression strength of each sample tested, in pounds per square inch (GCS psi), is listed in the following tables under "Bonding properties." It is the maximum green strength developed by the clay at its optimum water content.

Suggested Uses

Many clay deposits may be satisfactory for use in more than one variety of fired clay product. Some types of clay products require clay with specific physical properties, but others can be made from several types of clay. Refractories made from underclays, for instance, can be made only from clays with a high kaolinite content, whereas the latitude of properties of clays used in stoneware is somewhat less restricted. Structural clay products, sewer pipe, and drain tile can be made from a wider variety of clays than either of the first two categories, and the requirements for flower pot clay are the least stringent. The sequence, then, running from products that demand clay having specific properties to products that can use clay of several types is (1) refractories, (2) stoneware, (3) structural clay products, sewer pipe, and drain tile, and (4) flower pots.

In the following tables under "Suggested uses" for each clay, the product listed first is the one highest in this sequence. The samples also may be acceptable for products (listed next) that are found lower in the sequence, but may not be satisfactory for use in products found higher in the sequence.

Lightweight aggregate and bonding clay are not included in the above list of products but are listed in the following tables for samples suitable for such use. All of the underclays tested are suitable for some form of art pottery (Jonas, 1957). 1957).

Results of all tests made during this investigation appear in the following tables.

RESULTS OF TESTS

ROCK ISLAND COUNTY

SAMPLE 1593

NE $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 28, T. 17 N., R. 1 W.

	Thickness:	Ft.	In.	Extrusion properties	
Overburden					Good
Overlying rocks		57		Water of plasticity, percent	16.9
Rock Island (No. 1) Coal		2	6	Linear drying shrinkage, percent	3.5
Underclay (sample 1593)		2	6		
Shale					

The underclay is in the lower part of the Spoon Formation.

Firing temperature	1832°F	2012°F	2200°F
Linear firing shrinkage, percent	1.2	5.5	5.0
Total linear shrinkage, percent	4.7	9.0	8.5
Fired color	Cream	Tan	Tan

Surface texture of fired test bar: Bloating started at 2200°F.

Bonding properties: 4.70 (GCS psi); 1.50 (Optimum H₂O).

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1594

SW $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 31, T. 17 N., R. 1 W.

	Ft.	In.	Extrusion properties	
Overburden				Good
Overlying rocks	100		Water of plasticity, percent	17.4
Coal	1	4 $\frac{1}{2}$	Linear drying shrinkage, percent	3.0
Underclay (sample 1594)	1	8 ⁺		
Base covered				

The underclay is in the middle part of the Abbott Formation.

Firing temperature	1832°F	2012°F	2200°F
Linear firing shrinkage, percent	0.0	5.0	5.7
Total linear shrinkage, percent	3.0	8.0	8.7
Fired color	Salmon	Salmon	Tan

Surface texture of fired test bar: Has rough edges at all firing temperatures. Bloating started at 2200°F.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1595

NE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 14, T. 17 N., R. 2 W.

Overburden	Ft.	In.	Extrusion properties		Fair
Overlying rocks	79		Water of plasticity, percent		20.2
Coal	1		Linear drying shrinkage, percent		3.0
Underclay (sample 1595) (lower [?] part of Spoon Formation)	2	6			
Shale					
Firing temperature			1832°F	2012°F	2200°F
Linear firing shrinkage, percent			1.4	6.7	5.0
Total linear shrinkage, percent			4.4	9.7	8.0
Fired color			Salmon	Salmon	Brown

Surface texture of fired test bar: Has rough edges at all firing temperatures. Bloating started at 2200°F.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1596

NW $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 25, T. 17 N., R. 1 W.

Overburden	Ft.	In.	Extrusion properties		Fair
Overlying rocks	55		Water of plasticity, percent		16.9
Coal		10	Linear drying shrinkage, percent		3.5
Underclay (sample 1596) (lower part of Spoon Formation)	5				
Sandstone					
Firing temperature			1832°F	2012°F	2200°F
Linear firing shrinkage, percent			1.2	5.0	6.7
Total linear shrinkage, percent			4.7	8.5	10.2
Fired color			Salmon	Salmon	Brown

Surface texture of fired test bar: Normal.

Bonding properties: 6.46 (GCS psi); 1.70 (Optimum H₂O).

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1597

SW $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 25, T. 17 N., R. 1 W.

Overburden	Ft.	In.	Extrusion properties		Good
Overlying rocks	55		Water of plasticity, percent		22.9
Coaly shale		8	Linear drying shrinkage, percent		3.5
Underclay (sample 1597) (lower part of Spoon Formation)	7				
Coaly seam	1	6			
Firing temperature			1832°F	2012°F	2200°F
Linear firing shrinkage, percent			0.9	4.7	7.9
Total linear shrinkage, percent			4.4	8.2	11.4
Fired color			Salmon	Salmon	Tan

Surface texture of fired test bar: Normal.

Bonding properties: 3.85 (GCS psi); 1.45 (Optimum H₂O).

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

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SAMPLE 1598

SW $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 25, T. 17 N., R. 1 W.

Overburden	Ft.	In.	Extrusion properties	Fair
Overlying rocks	65		Water of plasticity, percent	17.9
Coaly seam	1	6	Linear drying shrinkage, percent	2.5
Underclay (sample 1598) (upper [?] part of Abbott Formation)	2+ (exposed)			
Shale				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		0.2	2.6	7.7
Total linear shrinkage, percent		2.7	5.1	10.2
Fired color		Salmon	Salmon	Brown

Surface texture of fired test bar: Normal.

Bonding properties: 3.25 (GCS psi); 1.50 (Optimum H₂O).

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1599

SE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 5, T. 17 N., R. 1 E.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	27		Water of plasticity, percent	13.7
Ironstone nodules		6	Linear drying shrinkage, percent	3.5
Underclay (sample 1599) (upper [?] part of Abbott Formation)	10+ (exposed)			
Sandstone				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		0.3	2.5	3.4
Total linear shrinkage, percent		3.8	6.0	6.9
Fired color		Buff	Buff	Tan

Surface texture of fired test bar: Normal.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1600

SE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 5, T. 17 N., R. 1 E.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	25		Water of plasticity, percent	14.0
Coaly ironstone shale	1		Linear drying shrinkage, percent	3.0
Underclay (sample 1600) (upper [?] part of Abbott Formation)	0-10			
Shale				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		0.2	1.7	3.1
Total linear shrinkage, percent		3.2	4.7	6.1
Fired color		Salmon	Salmon	Tan

Surface texture of fired test bar: Normal.

Bonding properties: 2.32 (GCS psi); 1.40 (Optimum H₂O).

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1601

NE $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 4, T. 17 N., R. 1 E.

Overburden	Ft.	In.	Extrusion properties	Fair
Overlying rocks	60		Water of plasticity, percent	16.4
Coal streak		3	Linear drying shrinkage, percent	3.0
Underclay (sample 1601) (lower part of Spoon Formation)	2			
Silty shale				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		0.7	2.9	4.8
Total linear shrinkage, percent		3.7	5.9	7.0
Fired color		Salmon	Salmon	Tan

Surface texture of fired test bar: Normal.

Bonding properties: 3.12 (GCS psi); 2.14 (Optimum H₂O).

Suggested uses: Stoneware, structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1602

SW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 8, T. 17 N., R. 1 E.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	60		Water of plasticity, percent	15.9
Underclay (sample 1602) (lower [?] part of Spoon Formation)	2+	(exposed)	Linear drying shrinkage, percent	3.5
Base covered				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		1.2	3.4	4.1
Total linear shrinkage, percent		4.7	6.9	7.6
Fired color		Salmon	Salmon	Tan

Surface texture of fired test bar: Normal.

Bonding properties: 4.18 (GCS psi); 1.33 (Optimum H₂O).

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1603

SE $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 9, T. 17 N., R. 1 E.

Overburden	Ft.	In.	Extrusion properties	Fair
Overlying rocks	40		Water of plasticity, percent	20.0
Coal	1		Linear drying shrinkage, percent	4.0
Underclay (sample 1603) (lower part of Spoon Formation)	2+	(exposed)		
Base covered				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		0.9	5.0	+0.5
Total linear shrinkage, percent		4.9	9.0	3.5
Fired color		Salmon	Brown	Tan

Surface texture of fired test bar: Bloating started at 2200°F.

Suggested uses: Lightweight aggregate, structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1604

SE $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 9, T. 17 N., R. 1 E.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	45		Water of plasticity, percent	18.3
Coal		7	Linear drying shrinkage, percent	3.0
Underclay (sample 1604) (lower part of Spoon Formation)	1	6+ (exposed)		
Base covered				

Firing temperature	1832°F	2012°F	2200°F
Linear firing shrinkage, percent	0.3	3.4	5.5
Total linear shrinkage, percent	3.3	6.4	8.5
Fired color	Buff	Buff	Tan

Surface texture of fired test bar: Normal.

Bonding properties: 3.70 (GCS psi); 1.45 (Optimum H₂O).

Suggested uses: Stoneware, structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1605

NW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 9, T. 17 N., R. 1 E.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	80		Water of plasticity, percent	22.2
Rock Island (No. 1) Coal	1	8	Linear drying shrinkage, percent	3.0
Underclay (sample 1605) (lower part of Spoon Formation)	6			
Shale				

Firing temperature	1832°F	2012°F	2200°F
Linear firing shrinkage, percent	0.7	7.4	3.3
Total linear shrinkage, percent	3.7	10.4	6.3
Fired color	Salmon	Brick red	Brown

Surface texture of fired test bar: Bloating started at 2200°F.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1606

NE $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 26, T. 17 N., R. 4 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	33		Water of plasticity, percent	18.3
Coal		11	Linear drying shrinkage, percent	4.0
Underclay (sample 1606)	3			
Shale				

Firing temperature	1832°F	2012°F	2200°F
Linear firing shrinkage, percent	0.7	4.3	5.1
Total linear shrinkage, percent	4.7	8.3	9.1
Fired color	Buff	Buff	Tan

Surface texture of fired test bar: Normal.

Suggested uses: Stoneware, structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1607

NE $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 26, T. 17 N., R. 4 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	18		Water of plasticity, percent	24.0
Thin coal streak			Linear drying shrinkage, percent	3.5
Underclay (sample 1607)	2	7		
Shale				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		0.2	1.6	3.3
Total linear shrinkage, percent		3.7	5.1	6.8
Fired color		Cream	Cream	Buff

Surface texture of fired test bar: Normal.

Bonding properties: 3.10 (GCS psi); 1.50 (Optimum H₂O).

Suggested uses: Stoneware, structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1608

NE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 35, T. 17 N., R. 4 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	40		Water of plasticity, percent	21.6
Coal		5	Linear drying shrinkage, percent	6.0
Underclay (sample 1608)	3	6		
Black shale				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		1.0	4.2	6.3
Total linear shrinkage, percent		7.0	10.2	11.3
Fired color		Pink	Tan	Greenish tan

Surface texture of fired test bar: Normal.

Bonding properties: 5.90 (GCS psi); 2.20 (Optimum H₂O).

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1609

NE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 35, T. 17 N., R. 4 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	27		Water of plasticity, percent	17.6
Coaly streak		3	Linear drying shrinkage, percent	4.5
Underclay (sample 1609)	11			
Coal		5		
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		0.8	2.2	3.3
Total linear shrinkage, percent		5.3	6.7	7.8
Fired color		Cream	Cream	Cream

Surface texture of fired test bar: Normal.

Suggested uses: Stoneware, structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1610

NW $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 34, T. 17 N., R. 1 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	8		Water of plasticity, percent	20.8
Coal		9	Linear drying shrinkage, percent	4.0
Underclay (sample 1610) (middle [?] part of Spoon Formation)	1	6		
Shale				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		0.9	3.7	7.6
Total linear shrinkage, percent		4.9	7.7	11.6
Fired color		Salmon	Brick red	Brown

Surface texture of fired test bar: Normal.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1612

SE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 32, T. 17 N., R. 1 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	10-40		Water of plasticity, percent	15.7
Shaly coal		10	Linear drying shrinkage, percent	3.0
Underclay (sample 1612)	2+ (exposed)			
Base covered				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		+0.5	0.2	2.1
Total linear shrinkage, percent		2.5	3.2	5.1
Fired color		Cream	Cream	Buff

Surface texture of fired test bar: Normal.

Bonding properties: 2.15 (GCS psi); 1.16 (Optimum H₂O).

Suggested uses: Stoneware, structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1613

Center of E section line, sec. 11, T. 17 N., R. 1 W.

Overburden	Ft.	In.	Extrusion properties	Fair
Overlying rocks	40		Water of plasticity, percent	19.3
Coal		8	Linear drying shrinkage, percent	4.0
Underclay (sample 1613)	3	4		
Shale				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		1.2	4.5	5.2
Total linear shrinkage, percent		5.2	8.5	9.2
Fired color		Salmon	Brick red	Brown

Surface texture of fired test bar: Normal.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1614

SE $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 29, T. 17 N., R. 3 W.

Overburden	Ft.	In.	Extrusion properties	Fair
Overlying rocks	40		Water of plasticity, percent	18.8
Coal		5	Linear drying shrinkage, percent	4.5
Underclay (sample 1614) (middle part of Abbott Formation)	3	9		
Shale				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		1.9	6.3	5.1
Total linear shrinkage, percent		6.4	10.8	9.6
Fired color		Salmon	Brown	Brown

Surface texture of fired test bar: Bloating started at 2200°F.

Bonding properties: 5.55 (GCS psi); 1.80 (Optimum H₂O).

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1615

NW $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 21, T. 16 N., R. 4 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	16		Water of plasticity, percent	16.8
Coal	1	2	Linear drying shrinkage, percent	3.5
Underclay (sample 1615)	4	2		
Shale				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		0.9	3.8	5.5
Total linear shrinkage, percent		4.4	7.2	9.0
Fired color		Buff	Buff	Tan

Surface texture of fired test bar: Normal.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1616

NW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 27, T. 16 N., R. 5 W.

Rocks dipping 30° to 35° to N.E.			Extrusion properties	Good
Coal		9	Water of plasticity, percent	13.9
Coal			Linear drying shrinkage, percent	3.0
Underclay (sample 1616)	13			
Shale				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		+0.5	1.0	3.4
Total linear shrinkage, percent		2.5	4.0	7.4
Fired color		Cream	Buff	Tan

Surface texture of fired test bar: Normal.

Suggested uses: Stoneware, structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1617

SE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 30, T. 17 N., R. 3 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	16		Water of plasticity, percent	15.7
Coal		10	Linear drying shrinkage, percent	4.5
Underclay (sample 1617)	1+ (exposed)			
Sandstone?				

Firing temperature	1832°F	2012°F	2200°F
Linear firing shrinkage, percent	1.1	4.3	2.1
Total linear shrinkage, percent	5.6	8.8	6.6
Fired color	Salmon	Brick red	Tan

Surface texture of fired test bar: Bloating started at 2200°F.

Suggested uses: Lightweight aggregate, structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1618

NE $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 36, T. 17 N., R. 4 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	55		Water of plasticity, percent	19.3
Sandstone	1	7	Linear drying shrinkage, percent	3.5
Underclay (sample 1618) (lower part of Spoon Formation)	3	8+ (exposed)		
Base covered				

Firing temperature	1832°F	2012°F	2200°F
Linear firing shrinkage, percent	0.0	1.0	3.1
Total linear shrinkage, percent	3.5	4.5	6.6
Fired color	Cream	Cream	Buff

Surface texture of fired test bar: Normal.

Bonding properties: 3.33 (GCS psi); 1.33 (Optimum H₂O).

Suggested uses: Stoneware, structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1619

SE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 36, T. 17 N., R. 4 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	22		Water of plasticity, percent	25.9
Shaly limestone	3		Linear drying shrinkage, percent	6.5
Underclay (sample 1619) (middle part of Spoon Formation)	3	7		
Coal		4		

Firing temperature	1832°F	2012°F	2200°F
Linear firing shrinkage, percent	3.8	7.1	---
Total linear shrinkage, percent	10.3	13.6	---
Fired color	Brick red	Brick red	---

Surface texture of fired test bar: Bloating started at 2012°F.

Bonding properties: 9.50 (GCS psi); 1.85 (Optimum H₂O).

Suggested uses: Bonding clay, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1620

SE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 36, T. 17 N., R. 4 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	30		Water of plasticity, percent	16.6
Coal		4	Linear drying shrinkage, percent	4.0
Underclay (sample 1620) (middle part of Spoon Formation)	3+	(exposed)		
Base covered				

Firing temperature	1832°F	2012°F	2200°F
Linear firing shrinkage, percent	0.9	4.7	5.9
Total linear shrinkage, percent	4.9	8.7	9.9
Fired color	Salmon	Salmon	Tan

Surface texture of fired test bar: Normal.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1621

NW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 30, T. 17 N., R. 3 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	50		Water of plasticity, percent	17.3
Coal		1	Linear drying shrinkage, percent	4.0
Underclay (sample 1621) (lower [?] part of Spoon Formation)	3			

Sandstone

Firing temperature	1832°F	2012°F	2200°F
Linear firing shrinkage, percent	1.2	6.1	2.4
Total linear shrinkage, percent	5.2	10.1	6.4
Fired color	Salmon	Salmon	Tan

Surface texture of fired test bar: Bloating started at 2200°F.

Suggested uses: Lightweight aggregate, structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1622

SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 30, T. 17 N., R. 3 W.

Overburden	Ft.	In.	Extrusion properties	Fair
Overlying rocks	19		Water of plasticity, percent	15.0
Coal	1	4	Linear drying shrinkage, percent	2.5
Underclay (sample 1622) (lower [?] part of Spoon Formation)	2	8+	(exposed)	

Base covered

Firing temperature	1832°F	2012°F	2200°F
Linear firing shrinkage, percent	0.2	2.7	5.1
Total linear shrinkage, percent	2.7	5.2	7.6
Fired color	Cream	Buff	Tan

Surface texture of fired test bar: Normal.

Suggested uses: Stoneware, structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1623

NE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 35, T. 17 N., R. 4 W.

Overburden	Ft.	In.	Extrusion properties	Poor
Overlying rocks	55		Water of plasticity, percent	14.4
Shale			Linear drying shrinkage, percent	3.0
Underclay (sample 1623) (Abbott [?] Formation)	3	10		
Sandy shale				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		0.7	4.1	5.5
Total linear shrinkage, percent		3.7	7.1	8.5
Fired color		Cream	Cream	Tan

Surface texture of fired test bar: Normal.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1624

NW $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 29, T. 17 N., R. 3 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	70		Water of plasticity, percent	14.6
Shale	5		Linear drying shrinkage, percent	3.0
Underclay (sample 1624) (middle part of Abbott Formation)	4			
Sandstone				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		0.5	4.0	5.7
Total linear shrinkage, percent		3.5	7.0	8.7
Fired color		Buff	Buff	Tan

Surface texture of fired test bar: Normal.

Suggested uses: Stoneware, structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1625

NE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 4, T. 16 N., R. 3 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	27		Water of plasticity, percent	24.3
Coal		2-3	Linear drying shrinkage, percent	6.5
Underclay (sample 1625) (middle part of Spoon Formation)	2	7+ (exposed)		
Base covered				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		4.3	4.6	---
Total linear shrinkage, percent		10.8	11.1	---
Fired color		Brick red	Brick red	---

Surface texture of fired test bar: Bloating started at 2012°F.

Bonding properties: 8.22 (GCS psi); 1.90 (Optimum H₂O).

Suggested uses: Bonding clay, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1626

NE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 4, T. 16 N., R. 3 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	24		Water of plasticity, percent	24.2
Shale	1		Linear drying shrinkage, percent	6.0
Underclay (sample 1626) (middle part of Spoon Formation)	2			
Coal		2-3		
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		2.5	3.9	---
Total linear shrinkage, percent		8.5	9.9	---
Fired color		Brick red	Brick red	---

Surface texture of fired test bar: Slight bloating at 2012°F.

Bonding properties: 8.52 (GCS psi); 1.90 (Optimum H₂O).

Suggested uses: Bonding clay, structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1627

NW $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 32, T. 17 N., R. 3 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	90		Water of plasticity, percent	18.9
Organic shale		9	Linear drying shrinkage, percent	3.5
Underclay (sample 1627) (middle part of Abbott Formation)	2+	(exposed)		
Base covered				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		+0.2	3.6	6.4
Total linear shrinkage, percent		3.3	7.1	9.9
Fired color		Buff	Salmon	Tan

Surface texture of fired test bar: Iron discoloration on top surface at all firing temperatures.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1628

SE $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 32, T. 17 N., R. 3 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	90		Water of plasticity, percent	19.1
Organic clay shale	2	4	Linear drying shrinkage, percent	4.5
Underclay (sample 1628) (middle part of Abbott Formation)	3	8		
Black shale				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		1.0	6.4	5.6
Total linear shrinkage, percent		5.5	11.0	10.1
Fired color		Salmon	Brick red	Brown

Surface texture of fired test bar: Slight bloating at 2200°F.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1629

NE $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 9, T. 17 N., R. 1 E.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	50		Water of plasticity, percent	13.8
Black fissile shale		6	Linear drying shrinkage, percent	3.0
Underclay (sample 1629) (lower part of Spoon Formation)	3	6		
Shale				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		+0.3	2.2	5.5
Total linear shrinkage, percent		2.7	5.2	8.5
Fired color		Salmon	Salmon	Tan

Surface texture of fired test bar: Iron discoloration on top surface at all firing temperatures.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1630

NE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 9, T. 17 N., R. 1 E.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	80		Water of plasticity, percent	17.4
Black shale		5	Linear drying shrinkage, percent	2.0
Underclay (sample 1630) (lower part of Spoon Formation)	4	2+ (exposed)		
Base covered				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		0.2	4.3	6.8
Total linear shrinkage, percent		2.2	6.3	8.8
Fired color		Salmon	Brick red	Brown

Surface texture of fired test bar: Slight bloating at 2200°F.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1631

SE $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 32, T. 17 N., R. 3 W.

Overburden	Ft.	In.	Extrusion properties	Fair
Overlying rocks	120		Water of plasticity, percent	15.8
Black shale	6+		Linear drying shrinkage, percent	2.0
Underclay (sample 1631) (lower part of Spoon Formation)	7	7+ (exposed)		
Base covered				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		0.7	4.4	5.8
Total linear shrinkage, percent		2.7	6.4	7.8
Fired color		Buff	Salmon	Tan

Surface texture of fired test bar: Normal.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1632

NE $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 25, T. 17 N., R. 4 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	25		Water of plasticity, percent	18.5
Coaly shale		8	Linear drying shrinkage, percent	4.5
Underclay (sample 1632) (middle part of Abbott Formation)	3			
Shale				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		1.4	4.4	4.0
Total linear shrinkage, percent		5.9	8.9	8.5
Fired color		Salmon	Brick red	Brown

Surface texture of fired test bar: Slight bloating at 2200°F.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1633

SW $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 5, T. 16 N., R. 3 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	65		Water of plasticity, percent	26.2
Coal		$\frac{1}{2}$ -1	Linear drying shrinkage, percent	5.5
Underclay (sample 1633) (middle part of Spoon Formation)	3	2		
Shale				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		0.2	4.9	+0.4
Total linear shrinkage, percent		5.7	10.4	5.1
Fired color		Salmon	Brown	Tan

Surface texture of fired test bar: Bloating started at 2200°F.

Bonding properties: 7.04 (GCS psi); 1.80 (Optimum H₂O).

Suggested uses: Bonding clay, lightweight aggregate, structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1634

NE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 31, T. 17 N., R. 3 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	40		Water of plasticity, percent	15.3
Shale			Linear drying shrinkage, percent	3.5
Underclay (sample 1634) (lower part of Spoon Formation)	7	6+ (exposed)		
Base covered				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		0.0	1.9	4.0
Total linear shrinkage, percent		3.5	5.4	7.5
Fired color		Buff	Salmon	Tan

Surface texture of fired test bar: Normal.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1635

NW $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 31, T. 17 N., R. 3 W.

Overburden	Ft.	In.	Extrusion properties	Fair
Overlying rocks	80		Water of plasticity, percent	12.8
Sandstone	1		Linear drying shrinkage, percent	2.0
Underclay (sample 1635) (upper part of Abbott Formation)	3			
Shale				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		0.0	1.0	1.5
Total linear shrinkage, percent		2.0	3.0	3.5
Fired color		Cream	Salmon	Tan

Surface texture of fired test bar: Small blisters on surface at 2012°F.

Suggested uses: Stoneware, structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1636

NW $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 30, T. 17 N., R. 1 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	65		Water of plasticity, percent	22.5
Glacial till			Linear drying shrinkage, percent	4.5
Shale (sample 1636) (lower part of Abbott Formation)	10			
Sandstone				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		1.2	7.0	---
Total linear shrinkage, percent		5.7	11.5	---
Fired color		Salmon	Brick red	---

Surface texture of fired test bar: Surface blistered at 2012°F.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1669

SE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 25, T. 17 N., R. 4 W.

Overburden	Ft.	In.	Extrusion properties	Fair
Overlying rocks	40		Water of plasticity, percent	20.6
Coal	1		Linear drying shrinkage, percent	5.0
Underclay (sample 1669) (middle part of Abbott Formation)	1	6		
Green clay band				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		2.3	4.8	4.8
Total linear shrinkage, percent		7.3	9.8	9.8
Fired color		Salmon	Tan	Buff

Surface texture of fired test bar: Normal.

Suggested uses: Stoneware, structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1670

NE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 25, T. 17 N., R. 4 W.

Overburden	Ft.	In.	Extrusion properties	Fair	
Overlying rocks	70		Water of plasticity, percent	15.1	
Coal		1	Linear drying shrinkage, percent	3.5	
Underclay (sample 1670) (upper part of Abbott Formation)	3+ (exposed)				
Base covered					
Firing temperature			1832°F	2012°F	2200°F
Linear firing shrinkage, percent			2.0	4.4	4.5
Total linear shrinkage, percent			5.5	7.9	8.0
Fired color			Cream	Tan	Greenish tan

Surface texture of fired test bar: Surface scumming at 2012°F.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1671

NE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 2, T. 16 N., R. 5 W.

Overburden	Ft.	In.	Extrusion properties	Good	
Overlying rocks	78		Water of plasticity, percent	19.5	
Coal	2		Linear drying shrinkage, percent	4.0	
Underclay (sample 1671)	3				
Shale					
Firing temperature			1832°F	2012°F	2200°F
Linear firing shrinkage, percent			4.2	5.3	6.0
Total linear shrinkage, percent			7.0	9.4	10.3
Fired color			Salmon	Buff	Greenish tan

Surface texture of fired test bar: Pock-marked by pyrite at all firing temperatures.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots.

SAMPLE 1672

NE $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 2, T. 16 N., R. 5 W.

Overburden	Ft.	In.	Extrusion properties	Good	
Overlying rocks	100		Water of plasticity, percent	15.5	
Coal		6	Linear drying shrinkage, percent	3.5	
Underclay (sample 1672) (middle [?] part of Abbott Formation)	4+ (exposed)				
Base covered					
Firing temperature			1832°F	2012°F	2200°F
Linear firing shrinkage, percent			1.1	2.6	2.9
Total linear shrinkage, percent			4.6	6.1	6.4
Fired color			Salmon	Brick red	Brick red

Surface texture of fired test bar: Surface scum at all firing temperatures. Slight warping at 2200°F. Pyrite pockmarks at 2200°F.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1673

SW $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 2, T. 16 N., R. 5 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	150		Water of plasticity, percent	17.8
Coal		10	Linear drying shrinkage, percent	3.5
Underclay (sample 1673) (lower part of Abbott Formation)	4+	(exposed)		
Base covered				

Firing temperature	1832°F	2012°F	2200°F
Linear firing shrinkage, percent	1.1	3.6	6.0
Total linear shrinkage, percent	4.6	7.1	9.5
Fired color	Buff	Salmon	Brown

Surface texture of fired test bar: Normal.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1674

SW $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 3, T. 16 N., R. 5 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	60		Water of plasticity, percent	20.0
Coal	1		Linear drying shrinkage, percent	4.5
Underclay (sample 1674) (middle [?] part of Abbott Formation)	1-5			

Sandstone

Firing temperature	1832°F	2012°F	2200°F
Linear firing shrinkage, percent	2.1	5.5	5.7
Total linear shrinkage, percent	6.6	10.0	10.2
Fired color	Salmon	Brick red	Brown

Surface texture of fired test bar: Normal.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1675

NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 11, T. 16 N., R. 5 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	80		Water of plasticity, percent	17.5
Ironstone nodular layer	1		Linear drying shrinkage, percent	3.5
Underclay (sample 1675) (upper part of Abbott Formation)	3	6+	(exposed)	

Base covered

Firing temperature	1832°F	2012°F	2200°F
Linear firing shrinkage, percent	1.5	3.5	5.1
Total linear shrinkage, percent	5.0	7.0	8.6
Fired color	Buff	Buff	Greenish tan

Surface texture of fired test bar: Normal.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1679

SE $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 6, T. 16 N., R. 4 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	100		Water of plasticity, percent	18.1
Coal	2		Linear drying shrinkage, percent	4.5
Underclay (sample 1679)	5			
Shale				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		0.5	3.6	5.8
Total linear shrinkage, percent		5.0	8.1	10.3
Fired color		Buff	Buff	Greenish tan

Surface texture of fired test bar: Normal.

Suggested uses: Stoneware, structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1680

SE $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 6, T. 16 N., R. 4 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	90		Water of plasticity, percent	19.0
Coal streak			Linear drying shrinkage, percent	4.0
Underclay (sample 1680)	3+	(exposed)		
Base covered				

Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		1.4	3.1	4.3
Total linear shrinkage, percent		5.4	7.1	8.3
Fired color		Pink	Buff	Greenish tan

Surface texture of fired test bar: Slight warping at all firing temperatures.

Suggested uses: Drain tile, flower pots.

SAMPLE 1681

NW $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 11, T. 16 N., R. 5 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	75		Water of plasticity, percent	18.8
Black shale	1	6	Linear drying shrinkage, percent	3.5
Underclay (sample 1681)				
(upper [?] part of Abbott Formation)	6			
Coal		1		

Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		1.9	4.0	5.6
Total linear shrinkage, percent		5.4	7.5	9.1
Fired color		Buff	Buff	Greenish tan

Surface texture of fired test bar: Slight surface scum at 2012°F.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1682

NE $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 11, T. 16 N., R. 5 W.

Overburden	Ft.	In.	Extrusion properties	Good	
Overlying rocks	75		Water of plasticity, percent	18.2	
Coal	1	5	Linear drying shrinkage, percent	4.0	
Underclay (sample 1682)					
(lower [?] part of					
Spoon Formation)	3+	(exposed)			
Base covered					
Firing temperature			1832°F	2012°F	2200°F
Linear firing shrinkage, percent			1.3	3.6	4.6
Total linear shrinkage, percent			5.3	7.6	8.6
Fired color			Cream	Cream	Cream

Surface texture of fired test bar: Slight surface scum at 2012°F.

Suggested uses: Stoneware, structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1684

SE $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 28, T. 17 N., R. 3 W.

Overburden	Ft.	In.	Extrusion properties	Good	
Overlying rocks	60		Water of plasticity, percent	14.5	
Ironstone nodular layer		6	Linear drying shrinkage, percent	3.5	
Underclay (sample 1684)					
(middle [?] part of					
Abbott Formation)	5+	(exposed)			
Base covered					
Firing temperature			1832°F	2012°F	2200°F
Linear firing shrinkage, percent			0.7	1.7	4.1
Total linear shrinkage, percent			4.1	5.2	7.6
Fired color			Cream	Buff	Greenish tan

Surface texture of fired test bar: Normal.

Suggested uses: Stoneware, structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1685

SE $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 1, T. 16 N., R. 5 W.

Overburden	Ft.	In.	Extrusion properties	Fair	
Overlying rocks	100		Water of plasticity, percent	24.8	
Ironstone nodular layer		6	Linear drying shrinkage, percent	3.5	
Underclay (sample 1685)					
(middle [?] part of Abbott					
Formation)	3				
Shale					
Firing temperature			1832°F	2012°F	2200°F
Linear firing shrinkage, percent			3.0	6.1	6.5
Total linear shrinkage, percent			6.5	9.6	10.0
Fired color			Salmon	Brick red	Brown

Surface texture of fired test bar: Slight bloating started at 2200°F.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1686

SW $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 6, T. 16 N., R. 4 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	6		Water of plasticity, percent	23.0
Coal		6	Linear drying shrinkage, percent	4.5
Underclay (sample 1686)	3			
Coal		2		
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		4.1	7.2	6.1
Total linear shrinkage, percent		8.6	11.7	10.6
Fired color		Salmon	Brick red	Brick red

Surface texture of fired test bar: Slight surface scum at 1832°F and 2012°F. Slight bloating at 2200°F.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1687

SW $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 6, T. 16 N., R. 4 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	10		Water of plasticity, percent	21.0
Coal		2	Linear drying shrinkage, percent	4.5
Underclay (sample 1687)	2+	(exposed)		
Base covered				

Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		3.1	5.4	5.3
Total linear shrinkage, percent		7.0	10.0	10.1
Fired color		Salmon	Tan	Greenish tan

Surface texture of fired test bar: Normal.

Suggested uses: Stoneware, structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1688

NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 8, T. 16 N., R. 4 W.

Overburden	Ft.	In.	Extrusion properties	Poor
Overlying rocks	90		Water of plasticity, percent	13.7
Coal	1		Linear drying shrinkage, percent	3.5
Underclay (sample 1688)	3	10		
Sandstone				

Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		0.1	1.7	2.9
Total linear shrinkage, percent		3.6	5.2	6.4
Fired color		Salmon	Salmon	Buff

Surface texture of fired test bar: Lime pits at 2200°F.

Bonding properties: 4.10 (GCS psi); 1.30 (Optimum H₂O).

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1689

NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 8, T. 16 N., R. 4 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	50		Water of plasticity, percent	17.5
Sandstone			Linear drying shrinkage, percent	4.0
Underclay (sample 1689)	2	6		
Shale				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		0.6	2.1	4.1
Total linear shrinkage, percent		4.6	6.1	8.1
Fired color		Pink	Cream	Cream

Surface texture of fired test bar: Normal.

Suggested uses: Stoneware, structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1708

NW $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 32, T. 17 N., R. 4 W.

Overburden	Ft.	In.	Extrusion properties	Fair
Overlying rocks	100		Water of plasticity, percent	17.0
Coal streak		$\frac{1}{4}$	Linear drying shrinkage, percent	3.5
Underclay (sample 1708)	1	6+ (exposed)		
Base covered				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		2.5	3.5	5.1
Total linear shrinkage, percent		6.0	7.0	8.6
Fired color		Cream	Buff	Greenish tan

Surface texture of fired test bar: Normal.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1709

NE $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 28, T. 17 N., R. 3 W.

Overburden	Ft.	In.	Extrusion properties	Fair
Overlying rocks	50		Water of plasticity, percent	15.5
Coal		8	Linear drying shrinkage, percent	4.0
Underclay (sample 1709)	1	6+ (exposed)		
Base covered				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		1.8	3.4	4.8
Total linear shrinkage, percent		5.0	8.0	7.8
Fired color		Salmon	Brick red	Red brown

Surface texture of fired test bar: Slight surface scum at 1832°F and 2012°F.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

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SAMPLE 1581

SW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 23, T. 14 N., R. 2 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	20	6	Water of plasticity, percent	18.0
Colchester (No. 2) Coal	1	4	Linear drying shrinkage, percent	3.5
Underclay (sample 1581) (upper part of Spoon Formation)	3			
Silty shale				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		+0.2	1.7	3.1
Total linear shrinkage, percent		3.3	5.2	6.6
Fired color		Pink	Tan	Brick red

Surface texture of fired test bar: Iron discoloration on top surface at all firing temperatures.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1706

SE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 32, T. 14 N., R. 2 W.

Overburden	Ft.	In.	Extrusion properties	Fair
Overlying rocks	39		Water of plasticity, percent	18.5
Rock Island (No. 1) Coal	1	6	Linear drying shrinkage, percent	3.5
Underclay (sample 1706) (lower part of Spoon Formation)	2			
Sandstone				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		1.7	5.3	6.7
Total linear shrinkage, percent		5.2	8.8	10.2
Fired color		Salmon	Brick red	Brick red

Surface texture of fired test bar: Surface scum at 2012°F and 2200°F. Iron discoloration on top surface at 2200°F.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1707

NW $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 5, T. 14 N., R. 2 W.

Overburden	Ft.	In.	Extrusion properties	Fair
Overlying rocks	36		Water of plasticity, percent	18.0
Rock Island (No. 1) Coal	3	6	Linear drying shrinkage, percent	3.0
Underclay (sample 1707) (lower part of Spoon Formation)	4+	(exposed)		
Base covered				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		1.6	5.8	6.1
Total linear shrinkage, percent		4.6	8.8	9.1
Fired color		Salmon	Salmon	Brown

Surface texture of fired test bar: Iron discoloration on top surface at all firing temperatures. Slight bloating at 2200°F.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1710

SE $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 33, T. 14 N., R. 2 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	7		Water of plasticity, percent	19.5
Rock Island (No. 1) Coal		4	Linear drying shrinkage, percent	4.5
Underclay (sample 1710) (lower part of Spoon Formation)	5			
Black shale				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		0.2	2.2	3.8
Total linear shrinkage, percent		4.7	6.7	8.3
Fired color		Cream	Cream	Cream

Surface texture of fired test bar: Normal.

Bonding properties: 3.56 (GCS psi); 1.40 (Optimum H₂O).

Suggested uses: Stoneware, structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1711

SW $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 1, T. 13 N., R. 2 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	60		Water of plasticity, percent	21.8
Colchester (No. 2) Coal	1	6	Linear drying shrinkage, percent	6.5
Underclay (sample 1711) (upper part of Spoon Formation)	2+	(exposed)		
Base covered				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		0.7	3.5	2.6
Total linear shrinkage, percent		7.2	10.0	9.1
Fired color		Cream	Cream	Cream

Surface texture of fired test bar: Few dark pyrite spots on surfaces.

Bonding properties: 6.15 (GCS psi); 1.62 (Optimum H₂O).

Suggested uses: Stoneware, structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1712

NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 5, T. 13 N., R. 2 W.

Overburden	Ft.	In.	Extrusion properties	Poor
Overlying rocks	25		Water of plasticity, percent	20.0
Coal	2		Linear drying shrinkage, percent	4.5
Underclay (sample 1712) (upper part of Abbott Formation)	3			
Silty shale				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		2.0	5.0	5.5
Total linear shrinkage, percent		6.5	9.5	10.0
Fired color		Salmon	Salmon	Greenish tan

Surface texture of fired test bar: Slight warping at all firing temperatures.

Suggested uses: Drain tile, flower pots.

SAMPLE 1713

SE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 33, T. 15 N., R. 3 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	50		Water of plasticity, percent	16.5
Sandstone	1	6	Linear drying shrinkage, percent	3.3
Underclay (sample 1713) (lower [?] part of Spoon Formation)	3			
Coal streak		3 $\frac{1}{2}$		
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		0.0	1.7	2.0
Total linear shrinkage, percent		3.3	5.0	5.3
Fired color		Cream	Cream	Cream

Surface texture of fired test bar: Normal.

Bonding properties: 3.30 (GCS psi); 1.17 (Optimum H₂O).

Suggested uses: Stoneware, structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1714

NE $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 35, T. 15 N., R. 3 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	13		Water of plasticity, percent	22.4
Coal streak		2	Linear drying shrinkage, percent	4.5
Underclay (sample 1714) (lower [?] part of Spoon Formation)	3	6		
Coal streak		$\frac{1}{4}$		
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		1.8	5.5	6.0
Total linear shrinkage, percent		6.3	10.0	10.5
Fired color		Pink	Buff	Greenish tan

Surface texture of fired test bar: Normal.

Suggested uses: Stoneware, structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1715

NE $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 35, T. 15 N., R. 3 W.

Overburden	Ft.	In.	Extrusion properties	Fair
Overlying rocks	17		Water of plasticity, percent	17.3
Coal streak		$\frac{1}{4}$	Linear drying shrinkage, percent	3.0
Underclay (sample 1715) (lower [?] part of Spoon Formation)	4	6		
Sandstone				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		1.6	4.0	5.3
Total linear shrinkage, percent		4.6	7.0	8.3
Fired color		Pink	Cream	Buff

Surface texture of fired test bar: Normal.

Suggested uses: Stoneware, structural clay products, sewer pipe, drain tile, flower pots, art pottery.

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SAMPLE 1716

NE $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 35, T. 15 N., R. 3 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	22		Water of plasticity, percent	16.5
Sandstone		6	Linear drying shrinkage, percent	3.5
Underclay (sample 1716) (lower [?] part of Spoon Formation)	4			
Shale				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		1.2	3.2	4.3
Total linear shrinkage, percent		4.7	6.7	7.8
Fired color		Pink	Cream	Buff

Surface texture of fired test bar: Normal.

Suggested uses: Stoneware, structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1717

SW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 32, T. 14 N., R. 2 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	70		Water of plasticity, percent	17.2
Coal	1?		Linear drying shrinkage, percent	3.5
Underclay (sample 1717) (lower part of Spoon Formation)	11			
Black shale				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		0.1	1.9	3.3
Total linear shrinkage, percent		3.6	5.4	6.8
Fired color		Salmon	Salmon	Buff

Surface texture of fired test bar: Slight warping at 2012°F and 2200°F.

Suggested uses: Stoneware, structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1718

NW $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 26, T. 14 N., R. 1 W.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	150		Water of plasticity, percent	23.9
Rock Island (No. 1) Coal	4		Linear drying shrinkage, percent	5.0
Underclay (sample 1718) (lower part of Spoon Formation)	3	6		
Shale				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		4.6	6.9	+20.5
Total linear shrinkage, percent		9.6	11.9	+15.5
Fired color		Salmon	Brick red	Greenish tan

Surface texture of fired test bar: Iron discoloration on top surface at all firing temperatures. Bloated at 2200°F.

Suggested uses: Lightweight aggregate, structural clay products, sewer pipe, drain tile, flower pots, art pottery.

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SAMPLE 1611

NE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 19, T. 17 N., R. 1 E.

Overburden	Ft.	In.	Extrusion properties	Fair
Overlying rocks	25		Water of plasticity, percent	16.7
Rock Island (No. 1) Coal	4		Linear drying shrinkage, percent	3.5
Underclay (sample 1611) (lower part of Spoon Formation)	6	6		
Shale				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		0.7	5.7	4.8
Total linear shrinkage, percent		4.2	7.2	8.3
Fired color		Salmon	Brick red	Brick red

Surface texture of fired test bar: Slight bloating at 2200°F.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1676

SE $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 30, T. 17 N., R. 1 E.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	20		Water of plasticity, percent	24.4
Coal		5	Linear drying shrinkage, percent	5.0
Underclay (sample 1676) (middle part of Spoon Formation)	1	4		
Coal		$\frac{1}{2}$		
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		3.0	6.1	6.8
Total linear shrinkage, percent		8.0	11.1	11.8
Fired color		Salmon	Brick red	Brick red

Surface texture of fired test bar: Normal.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1677

SE $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 30, T. 17 N., R. 1 E.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	22		Water of plasticity, percent	31.8
Coal		$\frac{1}{2}$	Linear drying shrinkage, percent	8.0
Underclay (sample 1677) (middle part of Spoon Formation)	2	2		
Coal		$\frac{1}{2}$		
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		5.0	7.8	7.0
Total linear shrinkage, percent		13.0	15.8	15.0
Fired color		Salmon	Brick red	Brick red

Surface texture of fired test bar: Slight warping and bloating at 2200°F.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1678

SE $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 30, T. 17 N., R. 1 E.

Overburden	Ft.	In.	Extrusion properties		Good
Overlying rocks	24		Water of plasticity, percent		34.4
Coal		$\frac{1}{2}$	Linear drying shrinkage, percent		6.5
Underclay (sample 1678) (middle part of Spoon Formation)	2	3			
Sandstone					
Firing temperature			1832°F	2012°F	2200°F
Linear firing shrinkage, percent			5.1	9.9	9.9
Total linear shrinkage, percent			11.6	16.4	16.4
Fired color			Salmon	Brick red	Brick red

Surface texture of fired test bar: Normal.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1683

SW $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 33, T. 14 N., R. 1 E.

Overburden	Ft.	In.	Extrusion properties		Poor
Overlying rocks	260		Water of plasticity, percent		13.2
Rock Island (No. 1) Coal	4	6	Linear drying shrinkage, percent		2.5
Underclay (sample 1683) (lower part of Spoon Formation)	4				
Silty sandstone					
Firing temperature			1832°F	2012°F	2200°F
Linear firing shrinkage, percent			2.1	3.8	5.4
Total linear shrinkage, percent			3.8	7.1	8.1
Fired color			Brick red	Brick red	Brown

Surface texture of fired test bar: Slight bloating and small pyrite blisters at 2200°F.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1690

NW $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 21, T. 17 N., R. 1 E.

Overburden	Ft.	In.	Extrusion properties		Good
Overlying rocks	16		Water of plasticity, percent		21.6
Coal		6	Linear drying shrinkage, percent		4.5
Underclay (sample 1690) (lower part of Spoon Formation)	3				
Shale					
Firing temperature			1832°F	2012°F	2200°F
Linear firing shrinkage, percent			2.5	5.7	6.3
Total linear shrinkage, percent			7.0	10.2	10.8
Fired color			Salmon	Salmon	Brown

Surface texture of fired test bar: Slight surface scum at 2012°F. Slight blistering at 2200°F.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1691

NE $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 21, T. 17 N., R. 1 E.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	15		Water of plasticity, percent	25.0
Black shale	1		Linear drying shrinkage, percent	4.5
Underclay (sample 1691) (lower part of Spoon Formation)	3	4		
Sandy clay				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		2.5	6.9	8.5
Total linear shrinkage, percent		7.0	11.4	13.0
Fired color		Pink	Salmon	Tan

Surface texture of fired test bar: Normal.

Bonding properties: 8.00 (GCS psi); 2.20 (Optimum H₂O).

Suggested uses: Bonding clay, structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1692

SE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 27, T. 17 N., R. 2 E.

Overburden	Ft.	In.	Extrusion properties	Fair
Overlying rocks	55		Water of plasticity, percent	15.2
Sandstone	5		Linear drying shrinkage, percent	3.0
Shale (sample 1692) (upper part of Spoon Formation)	20+	(exposed)		
Base covered				

Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		2.5	7.2	5.9
Total linear shrinkage, percent		6.5	10.2	8.9
Fired color		Brick red	Brick red	Red-brown

Surface texture of fired test bar: Slight bloating at 2200°F.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1693

NE $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 28, T. 17 N., R. 2 E.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	35		Water of plasticity, percent	23.5
Sandstone	2		Linear drying shrinkage, percent	5.0
Underclay (sample 1693) (middle part of Spoon Formation)	3	6+	(exposed)	
Base covered				

Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		2.0	5.0	5.5
Total linear shrinkage, percent		7.0	10.0	10.5
Fired color		Cream	Cream	Greenish tan

Surface texture of fired test bar: Warping at 2200°F.

Suggested uses: Stoneware, structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1694

NW $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 28, T. 17 N., R. 2 E.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	20		Water of plasticity, percent	23.4
Coal	1	3	Linear drying shrinkage, percent	3.5
Underclay (sample 1694) (middle part of Spoon Formation)	5	6		
Coal streak		1		
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		3.0	7.5	8.1
Total linear shrinkage, percent		6.5	11.0	11.6
Fired color		Salmon	Brick red	Brick red

Surface texture of fired test bar: Normal.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1695

NE $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 28, T. 17 N., R. 2 E.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	4		Water of plasticity, percent	24.2
Coal	2		Linear drying shrinkage, percent	3.5
Underclay (sample 1695) (lower part of Spoon Formation)	6			
Black shale				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		1.7	5.7	8.1
Total linear shrinkage, percent		4.7	9.5	12.2
Fired color		Salmon	Brick red	Brick red

Surface texture of fired test bar: Slight warping at 2012°F and 2200°F.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1696

SW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 34, T. 17 N., R. 2 E.

Overburden	Ft.	In.	Extrusion properties	Fair
Overlying rocks	12		Water of plasticity, percent	22.6
Sandstone	3	4	Linear drying shrinkage, percent	3.5
Underclay (sample 1696) (middle part of Spoon Formation)	5+	(exposed)		
Base covered				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		1.5	6.0	7.1
Total linear shrinkage, percent		5.0	9.5	10.6
Fired color		Pink	Tan	Greenish tan

Surface texture of fired test bar: Slight surface scum at 2012°F.

Suggested uses: Stoneware, structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1697

NE $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 21, T. 17 N., R. 1 E.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	10		Water of plasticity, percent	25.0
Coal	1		Linear drying shrinkage, percent	4.0
Underclay (sample 1697) (middle part of Spoon Formation)	3			
Coaly shale				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		3.2	6.8	7.6
Total linear shrinkage, percent		7.2	10.8	11.6
Fired color		Pink	Salmon	Brown

Surface texture of fired test bar: Slight warping at 2200°F.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1698

SE $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 27, T. 17 N., R. 1 E.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	18		Water of plasticity, percent	12.5
Coal		10	Linear drying shrinkage, percent	4.0
Underclay (sample 1698) (middle [?] part of Spoon Formation)	2	6+ (exposed)		
Base covered				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		1.8	4.1	5.6
Total linear shrinkage, percent		5.8	8.1	9.6
Fired color		Cream	Buff	Greenish tan

Surface texture of fired test bar: Normal.

Suggested uses: Stoneware, structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1699

NE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 22, T. 17 N., R. 1 E.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	80		Water of plasticity, percent	18.0
Ironstone nodular layers	1	6	Linear drying shrinkage, percent	4.5
Underclay (sample 1699) (upper part of Abbott Formation)	2	6+ (exposed)		
Base covered				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		2.0	4.6	5.3
Total linear shrinkage, percent		7.0	8.6	10.3
Fired color		Salmon	Brick red	Brown

Surface texture of fired test bar: Slight surface scum at 1832°F and 2012°F.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1700
 NE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 15, T. 18 N., R. 3 E.

Overburden	Ft.	In.	Extrusion properties	Fair
Overlying rocks	30		Water of plasticity, percent	19.3
Coal streak		$\frac{1}{2}$	Linear drying shrinkage, percent	3.5
Underclay (sample 1700) (lower part of Spoon Formation)	3	6		
Coal	1			
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		2.5	5.6	6.5
Total linear shrinkage, percent		6.0	9.1	10.0
Fired color		Cream	Cream	Greenish tan

Surface texture of fired test bar: Normal.

Suggested uses: Stoneware, structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1701
 NE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 15, T. 18 N., R. 3 E.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	35		Water of plasticity, percent	17.3
Coal	1		Linear drying shrinkage, percent	3.0
Underclay (sample 1701) (lower part of Spoon Formation)	3	9		
Shale				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		0.4	3.3	5.0
Total linear shrinkage, percent		3.4	6.3	8.0
Fired color		Salmon	Salmon	Tan

Surface texture of fired test bar: Iron discoloration on top surface at all firing temperatures.

Suggested uses: Stoneware, structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1702
 SE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 15, T. 18 N., R. 3 E.

Overburden	Ft.	In.	Extrusion properties	Poor
Overlying rocks	40		Water of plasticity, percent	15.0
Coal		8	Linear drying shrinkage, percent	2.5
Underclay (sample 1702) (lower part of Spoon Formation)	4+	(exposed)		
Base covered				
Firing temperature		1832°F	2012°F	2200°F
Linear firing shrinkage, percent		2.1	4.5	6.1
Total linear shrinkage, percent		4.6	7.0	8.6
Fired color		Cream	Cream	Cream

Surface texture of fired test bar: Normal.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1703

NW $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 24, T. 18 N., R. 2 E.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	70		Water of plasticity, percent	12.8
Rock Island (No. 1) Coal	3		Linear drying shrinkage, percent	3.0
Underclay (sample 1703) (lower part of Spoon Formation)	2	6+ (exposed)		
Base covered				

Firing temperature	1832°F	2012°F	2200°F
Linear firing shrinkage, percent	0.5	2.2	4.9
Total linear shrinkage, percent	3.5	5.2	7.9
Fired color	Salmon	Salmon	Tan

Surface texture of fired test bar: Iron discoloration on top surface at all firing temperatures.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1704

SE $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 23, T. 17 N., R. 1 E.

Overburden	Ft.	In.	Extrusion properties	Fair
Overlying rocks	40		Water of plasticity, percent	20.0
Coal		7	Linear drying shrinkage, percent	5.0
Underclay (sample 1704) (middle part of Spoon Formation)	3			
Silty sandstone				

Firing temperature	1832°F	2012°F	2200°F
Linear firing shrinkage, percent	2.3	4.8	5.2
Total linear shrinkage, percent	7.3	9.8	10.2
Fired color	Buff	Tan	Greenish tan

Surface texture of fired test bar: Surface scum at 2012°F.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SAMPLE 1705

NW $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 30, T. 17 N., R. 1 E.

Overburden	Ft.	In.	Extrusion properties	Good
Overlying rocks	38		Water of plasticity, percent	24.4
Coal	1	7	Linear drying shrinkage, percent	5.5
Underclay (sample 1705) (middle part of Spoon Formation)	4			
Sandy clay				

Firing temperature	1832°F	2012°F	2200°F
Linear firing shrinkage, percent	3.3	6.0	2.2
Total linear shrinkage, percent	8.3	11.0	8.6
Fired color	Salmon	Brick red	Tan

Surface texture of fired test bar: Warping and bloating at 2200°F.

Suggested uses: Structural clay products, sewer pipe, drain tile, flower pots, art pottery.

SUMMARY

Generally, an underclay with a light firing color will tend to be more refractory than clays that fire darker. Approximately half of the samples tested are light burning. However, none has a fusion temperature of PCE cone 28 or above, thus making their use as medium heat duty refractories unacceptable: Samples 1607, 1609, 1612, 1618, 1682, 1710, 1711, and 1713, based on their fired colors and mineralogical data, will have the highest fusion temperatures.

Samples 1619, 1625, 1626, 1633, and 1691 were found to have the greatest bonding strength.

The overburden for the outcrop samples varied from 6 to 150 feet. Fifty percent of the sample areas have overburden of 40 feet or less.

The test results show that there are many underclay deposits of commercial quality in the area of Rock Island, Mercer, and Henry Counties. Some of the thinner deposits of good quality that have thicknesses of overburden so great as to make them uneconomical today for industrial use may be of value locally to individuals or schools interested in making small amounts of art pottery.

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CIRCULAR 322

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